For more than a decade, cable operators in India have also delivered broadband (internet) services to their customers. Often, a low cost data network is installed completely separate from the cable network. However these networks and other solutions such as MAN and Ethernet over Coax (EoC) are limited in the amount of high speed data they can deliver.

Cable modems have always provided much higher data speeds but require higher investments and better quality distribution networks.

As Indian cable networks go digital, their quality has improved and they can provide cable modem services also.

**BROADBAND & CATV REVENUES**

Digital cable TV revenues from consumers are still restricted around ₹ 300 per month with additional charges for HD services. There is strong consumer resistance to pay more for monthly cable TV entertainment.

However consumers are happy to pay ₹ 600 to ₹ 2000 per month for high speed broadband services.

Consumers Refuse To Pay More Than ₹ 350 for CATV But Will Pay ₹ 600 To ₹ 2,000 For Broadband.

Clearly cable modems and broadband delivery provide far better returns to cable networks than digital CATV.

With the advent of wireless 4G data services, wired broadband services will have to either drop prices or deliver much higher data speeds than 4G to remain competitive. Cable modems provide the ideal solution and the fastest speeds for broadband delivery compared to any other wired technology such as DSL, EoC, MAN networks etc.
Several large MSO's have already rolled out high speed (50 Mbps) broadband services in India using DOCSIS-3 cable modems. This article provides a quick overview of the DOCSIS specifications, technology and capabilities.

To Compete With 4G, Wired Broadband Must Deliver More Than 30 MBps

WHAT IS DOCSIS?
The term DOCSIS is an acronym for Data Over Cable Service Interface Specification. It is the foundation that defines how Cable Modems operate over a Cable TV network.

The first version of this specification was released 1997, and simply called DOCSIS.

TWO 'LAYERS' IN DOCSIS
The DOCSIS specification can be separated broadly into 2 'layers' or levels. The PHYSical layer (PHY) and the Media Access Control (MAC) layer.

PHYSICAL LAYER IN DOCSIS
The physical layer, simply refers to all physical aspects, i.e. items that people can see and touch. It includes wiring and routing equipment. The physical layer also specifies of the frequency at which data is transmitted over the Cable TV coaxial cable.

MAC LAYER IN DOCSIS
The Media Access Control OR MAC layer are simply rules (protocols) that provide for orderly transmission of data to and from the hundreds of Cable modems on a network. The MAC layer is like a traffic police, who is

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4G के साथ प्रतिक्रिया के क्रम में वायरल युक्त ब्रॉडबैंड को 30 MBps से अधिक की निष्ठुरता से डिलीवरी करनी चाहिए

DOCSIS में दो लेयर हैं
DOCSIS के विज्ञापनका को मंडल तीर पर 2 लेयर्स या स्तर में अलग किया गया है। फिजिकल लेयर (PHY) और मीडिया एक्सेस कंट्रोल (MAC) लेयर।

DOCSIS में फिजिकल लेयर
फिजिकल लेयर का उपयोग आमतौर पर सभी फिजिकल तथ्यों के लिए किया जाता है यानि विशेषता निम्न में कि लंग इंटरनेट व महामूल कर सकते हैं। इसमें व्यवस्थापन व रज्जुिंग उपकरण आमतौर पर महंगे है। फिजिकल लेयर उस फ्रॉक्चुस की निष्ठुरता करता है जिससे कि डेटा का कंबन टीवी को- एक्सेस कंट्रोल मेनिंग पर ट्रांसमीट किया जाता है।

MAC में एमएसी लेयर
मीडिया एक्सेस कंट्रोल या एमएसी लेयर वह एक निम (प्रैंटकोल) है जो कि एक नेटवर्क पर एक हिंसा व आपसी व्यवस्थित दृष्टि प्राप्त के लिए प्रस्ताव किया जाता है।

MAC लेयर ड्राफ्ट रिपोर्ट का माना होता है जो कि सड़क
regulating the movement of cars (data Packets) along the roads (Coaxial Cables of a Cable TV network).
Without the MAC layer, the data packets would collide and not reach their intended Cable Modem.

**CMTS**
Just as a cable TV network has a digital Headend at a central location and thousands of STBs in consumer homes, for broadband delivery, each consumer must have a cable Modem, which is controlled by a central Cable Modem Termination System (CMTS) located at the Headend.

**UP & DOWN STREAM TRAFFIC**
As a user surfs the internet, he sends a request for a web page. This information is sent from the individual Cable modem to the CMTS is referred to as 'Upstream' traffic.
The CMTS finds the webpage on the internet, and send that data to the specific cable modem that requested the page. The data from the CMTS or Headend to the cable modem is called 'Downstream' traffic.

**MAC & IP ADDRESS**
Clearly, each cable modem must have a unique identify on the network, by which it is recognised and addressed by the CMTS.
Each cable modem has its own specific address and name.

**MAC ADDRESS**
The Cable modem's name is also called its MAC (Machine Access Control) address, and is embedded into the Cable modem by the manufacturer, at the factory. The MAC address is permanent and remains the same even if the Cable Modem is removed from one network and shifted to another network.
A MAC address is written as 12 hexadecimal characters (0-9, A-F). The 12 characters are grouped in pairs separated by colons, eg: 00:20:40:70:F4:84.
Every network device (Cable modem, network card etc) in the world has a unique MAC address. The first 6 characters of the MAC address identify the manufacturer of the device.

**IP ADDRESS**
The Cable Modem's address is called its IP Address, and is allocated to each cable modem by the CMTS. It is a group of 3 digit numbers such as 192.186.175.134. The IP address may change each
time the cable modem is switched on (Dynamically allocated) or fixed by the CMTS (static IP).

**IP**

IP (Internet Protocol) specifies the technical format of packets and the addressing scheme used over the internet.

If data packets within a Digital cable TV Headend follows this format, the digital Headend is referred to as an IP Headend. The IP protocol can be used by practically any device that needs to communicate / exchange data with other others. If the data is IP compatible, it can be easily connected to the internet.

**IPV4**

IPv4 (Internet Protocol Version 4) is the fourth revision of the Internet Protocol (IP) addressing system.

IPv4 has been widely used on the Internet for years. It uses 32-bit address scheme allowing for approximately 4.3 billion addresses.

For example, a 32-bit numeric address (IPv4) is written in decimal as 4 numbers (each 0 to 255) separated by a dot. An example of an IPv4 address is: 192.160.10.240

**IPV6**

With the very rapid growth of the internet and internet websites, the 4 billion IP addresses will soon run out.

This has led to the development of the IPv6 protocol, which are 128 bits long and can accommodate 3.4 x 10 followed by 37 zeros!

An IPv6 address could be: 3ffe:1900:4545:3:200:f8ff:fe21:67cf

The internet is gradually shifting from IPv4 to IPv6. Hence any new net enabled device, including a Cable modem, should preferably be capable of operating under IPv6 protocol.

### IPv6 Will Soon Replace IPv4

**DOCSIS**

The original DOCSIS 1.0 standard transmitted data over a single data channel on the Cable TV network.

**DOCSIS 1**

The original DOCSIS 1.0 standard transmitted data over a single data channel on the Cable TV network.
DOCSIS 1.1 was a minor improvement that enabled a larger number of cable modems and improved noise specifications.

A DOCSIS 1.x system can practically transmit a usable 38 Mbit/s downstream and approximately 9 Mbit/s of upstream. (On paper the specs are higher but do not work in practice due to network overheads).

DOCSIS 2

As competition from DSL and other forms of broadband surged after the year 2000, DOCSIS 2 was formulated.

The new standard maintained the same 38 MBps downstream speed but improved the upstream (reverse path) speed to 27 MBps. The upstream speed was increased by operating the upstream at QAM64, rather than QPSK digital modulation. The DOCSIS 2 cable modems had far superior noise performance in the upstream (reverse path) which allowed QAM64 in the upstream path.

The original DOCSIS 2 specification only supported the older IPv4. A subsequent modification supported IPv6.

<table>
<thead>
<tr>
<th>DOWNSTREAM / डाउनस्ट्रीम</th>
<th>UPSTREAM / अपस्ट्रीम</th>
<th>IP / आईपी</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPEED मीबिट प्रति सेकंड</td>
<td>FREQUENCY आयरनुम्बर (ग्यानदेवी की)</td>
<td>QAM क्यूएमएचएम</td>
</tr>
<tr>
<td>DOCSIS 1</td>
<td>36 Mbps</td>
<td>50MHz to 860MHz</td>
</tr>
<tr>
<td>DOCSIS 2</td>
<td>36 Mbps</td>
<td>88MHz to 860MHz</td>
</tr>
<tr>
<td>DOCSIS 3</td>
<td>144 Mbps+</td>
<td>108 MHz to 1 GHz</td>
</tr>
</tbody>
</table>

DOCSIS 3

While DOCSIS 2 was an incremental improvement, mainly in the Upstream (Reverse Path) speed, DOCSIS 3 leap-frogs the Cable Modem’s performance to an entirely different level.

While the older versions used a single data channel for downstream data transmission, DOCSIS 3 uses a minimum of 4 downstream data channels, and binds them together. These will support download data speeds of atleast 36x4=144 Mbps.

DOCSIS 3

हालांकि DOCSIS 2 ने एक वृद्धि भी मुश्किल किया, मुख्यमंत्र ने अपस्ट्रीम (रिवर्स पॉयर) में अपस्ट्रीम केवल मोडम के पेदलों को विस्तार अलग स्वर पर लगा पक्ष।

हालांकि पूर्व संक्रमण डाउनस्ट्रीम डेटा ड्रामपीली के लिए सीमित डेटा ड्रामपीली का इतिहास है, DOCSIS 3 नयनतानुसार 4 डाउनस्ट्रीम डेटा ड्रामलॉड का होना है और उन्हें एक साथ बंद करके है। जब यह से करता है 36x4=144 Mbps का डाउनलॉड स्पीड और
36x4 = 144 Mbps and upload speeds of 27x4 = 104 Mbps. Further, the number of channels used for either downstream or upstream can be increased as required, when network traffic grows.

DOCSIS 3 allows non-adjacent downstream channel bonding so that carriers do not have to re-carve their frequency allocation which would cause a change in the channel map.

There is no limit to the number of data channels that can be deployed under DOCSIS 3, and therefore the speeds delivered to the customer can be increased as required.

Comcast in the USA currently deploys 8 data channels to provide 100 Mbps to its business customers.

Download and upload speeds, at least for now are limited by what the customer is willing to pay.

**DOCSIS 3 Can Deliver More Than 100 Mb/s**

**DETERMINING SPEED**

The actual speed delivered by any cable modem (DOCSIS 1/2/3) is typically controlled by the operator, through the CMTS.

Every time a cable modem is switched on (brought online), the CMTS send the cable modem a small 'configuration file' which specifies, amongst other parameters, the maximum upstream and downstream speeds that the Cable modem will operate at. This is usually based on the tariff plan subscribed to.

**GIGABIT DOCSIS 3.1**

As technology and applications progress, there can never be enough speed.

Released October 2013, DOCSIS 3.1 is a speed demon! It supports capacities of at least 10 Gbit/s downstream and 1 Gbit/s upstream using 4096 QAM. The new specs will do away with 6 MHz (USA) and 8 MHz wide (Europe) channel spacing and instead use thousands of smaller (20 kHz to 50 kHz wide) Orthogonal Frequency Division Multiplexing (OFDM) subcarriers used for DTT transmissions. As in DTT, these multiple OFDM carriers can be bonded to very efficiently utilise the spectrum.

27x4 = 104 Mbps की अपलोड ग्यूड का समय-निष्ठा करता है। इसके अलावा आवश्यकता के मुद्दाबंध डाउनलोड या फिक्स अपडेट में इंटेन्सिव चैनलों की संख्या को बढ़ाना जा सकता है, जब इन्टेन्सिव में दृष्टि-विकस होता है।

DOCSIS 3 3 पर निभाती डाउनलोड चैनल संख्याओं को अनुपालन करता है जिसमें कि कैनिंग को अपनी पहले वटीनी आवार्य को फिर से बनाना न पड़, जिसमें गलत, चैनल मैप में परिवर्तन हो सकता है।

DOCSIS 3 के तहत डोटा चैनलों की संख्या की ओर से सीमा नहीं होती जिसे कि लगातार जा सकता है और इसलिए, उपभोक्ताओं को डिलीवरी की ग्यूड को आवश्यकता पड़ने पर ढुंढा जा सकता है।

2013 में कंपाक्ट-बॉयजुट में अपने वित्तियों उपभोक्ताओं के लिए 8 डोटा चैनल की सहायता में 100 Mbps दिन रहा है।

अभी के लिए उपभोक्ता किसी भी भाग करने के के तरह है डाउनलोड व अपलोड ग्यूड इस पर नियंत्रण करते है।

100 Mb/s में अवघड को डिलीवर कर सकता है DOCSIS 3

**स्पीड का निर्धारण**

किसी भी कैनल ग्यूड (DOCSIS 1/2/3) द्वारा डिलीवर वास्तविक ग्यूड को आवर्त पर सीएमएफ की सहायता में केवल आपरेटर के द्वारा निर्धारित किया जाता है।

हर बार कैनल ग्यूड को जब यूमी ऑन (अंतर्राष्ट्रीय द्वारा सहायता में) किया जाता है, सीएमएफ, केनल मॉडल को ग्रेटर ‘कॉम्फर्टेन्स फाइल’ भेजता है, जो बताता है कि अनु गांधकों के माध्यम से अब्दिम्म अपडेट और डाउनलोड ग्यूड जिम्रक के केनल मॉडल के संबंध में जानकारी करता है। यह आवर्त पर उपभोक्ता द्वारा लिये पाए टेक्निक ग्यूड पर आधारित होता है।

**गीगाबाइट DOCSIS 3.1**

तकनीकी और अविकर्षण के विकसित होने के माध्यम से पहला पर्याप्त ग्यूड कभी नहीं हो सकता।

अगस्त २०१३ में लॉन्च दोसिस 3.1 ग्यूड के गांधक में जाबाद है। वह 4096 QAM का इंटेन्सिव करके कभी से कंम १० Gbit/s डाउनलोड और १ Gbit/s अपडेट की सहायता का समय-निष्ठा करता है। नया विचित्रप्रणाली ६ (यूप्लाग) और १२ (यूप्लाग) चैनल यंगिंग का इंटेन्सिव करता है न तो डीडीटी डोमाइनियन के लिए हजारों कोई (२० kHz से ५० kHz बॉड) अंतर्राष्ट्रीय अनुवांशिक डिलीवर फ्लॉटिंग यंगिंग (ओएफडीएफ) वेबसाइट का। डीडीटी के के में वे विभिन्न ओएफडीएफ कैटीजियर, यंगिम का बंट दृष्टिकोण तरीके से इंटेन्सिव के लिए बन्ध रहते हैं।